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ABSTRACT

An achievement test for the secondary school vocational electricity programs in South Carolina was constructed by a research coordinating unit (RCU) project. A trade and industrial supervisor and consultant, three electricity instructors, and four industry representatives comprised an advisory committee that participated in its development. Three test forms were prepared and field tested in 27 Electricity I (340 students) and 27 Electricity II (242 students) classrooms. Test analysis findings indicated sufficiently high reliability indices to justify test use in classrooms. Twenty-seven items were tagged as needing further examination to determine whether they should be revised or eliminated from the item bank. In addition to a two-page report, the three test forms are provided. Form A contains 96 items; form B has 102 items; and form C has 96 items. These types of test items are included in the test forms: matching, true-false (statements with accompanying conditions), and multiple choice. (YLB)

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Electricity Test Construction Project

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Report

In July, 1982 the Research Coordinating Unit (RCU) began a project which required the construction of an achievement test for the secondary school vocational electricity programs in the state. The test was constructed by the RCU project director, with the assistance of an advisory committee consisting of the T & I supervisor and consultant, three electricity instructors, and four industry representatives.

The steps followed in construction of the test were:

1. Identification of content to be addressed on the test.
2. Content analysis of instructional materials to identify specific content elements.
3. Construction of a Table of Specifications.
4. Development of test items.
5. Preparation of three test forms for field test administration.
6. Field test administration of three test forms in twenty-seven Electricity I and twenty-seven Electricity II classrooms (340 Electricity I students and 242 Electricity II students).
7. Analysis of field test results using classical test item analysis procedures.

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Results:

The test analysis procedures established KR20 reliability indices of .927 for test Form A, .922 for test Form B, and .895 for test Form C.

In addition, item difficulty and discrimination indices calculated during the item analysis procedure flagged items which may have technical flaws or may lack content validity (seven of ninety-six items on Form A; eleven of 102 items on Form B; and, nine of ninety-six items on Form C).

Conclusions:

The test analysis findings indicate sufficiently high reliability indices to justify use of the tests in classrooms. However, twenty-seven individual items need further examination to determine whether they should be revised or eliminated from the item bank.

During FY '83, further analysis will be undertaken to determine what action should be taken regarding the twenty-seven questionable items. In addition, a detailed description of the field test findings and recommendations as to future use of the tests will be presented to the T & I supervisor.

FORM A

ELECTRICITY

STUDENT NAME: _____

TEACHER NAME: _____

CLASS: _____

DATE: _____

Directions: The two columns below contain descriptions of properties of electrical circuits and their basic unit of measurement for questions 1 - 6. You are to match each description from Column A with the proper unit of measure in Column B. Choices in Column B may be used once, more than once, or not at all. Remember to record your answer by placing an **"X"** in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

	Column A		Column B
____ 1.	inductance	1)	ohm
____ 2.	resistance	2)	coulomb
____ 3.	capacitive reactance	3)	farad
____ 4.	AC frequency	4)	henry
____ 5.	inductive reactance	5)	hertz
____ 6.	capacitance		

Directions: The two columns below contain descriptions of properties of electrical circuits and their basic unit of measurement for questions 7 - 11. You are to match each description from Column A with the proper unit of measure in Column B. Choices in Column B may be used once, more than once, or not at all. Remember to record your answer by placing an **"X"** in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

	Column A		Column B
____ 7.	electric power	1)	ampere
____ 8.	electromotive force	2)	volt
____ 9.	capacitive reactance	3)	watt
____ 10.	applied electrical pressure	4)	ohm
____ 11.	current	5)	farad

Directions: For questions 12 - 16 read each statement from Column A and choose from Column B the meter being described. Choices from Column B may be used once, more than once, or not at all. Remember to record your answer by placing an **"X"** in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

	Column A		Column B
____ 12.	Must always be connected in series	1)	ammeter
____ 13.	Measures electrical pressure	2)	ohmmeter
____ 14.	Measures amount of current in a circuit	3)	voltmeter
____ 15.	Should never be used on a device which has power applied	4)	wattmeter
____ 16.	A multiplier is used to increase measurement range		

Listed below are 6 statements with accompanying conditions. You are to read each statement and condition and respond according to the following key:

Mark:

1 - the statement is true if the condition applies
2 - the statement is true regardless of the condition
3 - the statement is false if the condition applies
4 - the statement is false regardless of the condition
5 - it is impossible to determine without more information

Remember to record your answer by placing an **"X"** in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

		Statement	Condition
17.	____	The direction of the flow of electrons through a conductor is irreversible, even	if the charges on the terminals are reversed
18.	____	Two charges objects repel each other	if both attract similarly charged objects
19.	____	In a circuit electrons move along one path only	if the circuit is connected in series
20.	____	Increasing the number of amperes in an electromagnet will increase the strength of the magnetic field	if the electromagnet has an iron core
21.	____	Increasing the number of turns in a coil will decrease the strength of an electromagnet	if the electron is toward the northern polarity
22.	____	As the intensity of current flow increases, ammeter deflection increases proportionately	if the ammeter is set on a linear scale

Directions: Questions **23** through **96** are all multiple choice items. You are to respond by choosing the **ONE** alternative which **BEST** answers the question or completes the statement. Remember to record your answer by placing an **"X"** in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet. Some of the items require you to use some math to figure the answers. For these items, you may use any blank space in the margins of the test booklet for your calculations.

23. The value of which of the following units of measure should be substituted for the "f" in the formula $X_C = \frac{1}{2\pi fC}$?

____ 1. henrys
____ 2. hertz
____ 3. farads
____ 4. ohms

24. The value of which of the following units of measure should be substituted for the "C" in the formula $X_C = \frac{1}{2\pi fC}$?

___ 1. henrys
___ 2. hertz
___ 3. farads
___ 4. ohms

25. The value of which of the following units of measure should be substituted for the "L" in the formula $X_L = 2\pi fL$?

___ 1. henrys
___ 2. hertz
___ 3. farads
___ 4. ohms

26. The value of which of the following units of measure should be substituted for the "Z" in the formula $I = E/Z$?

___ 1. henrys
___ 2. hertz
___ 3. farads
___ 4. ohms

Questions 27 and 28 both refer to the following information:

Four different materials are ranked as to their ability to become magnetized.
Material A is ranked #1, or highest ability to become magnetized.
Material B is ranked #2, or second highest ability to become magnetized.
Material C is ranked #3, or third highest ability to become magnetized.
Material D is ranked #4, or least ability to become magnetized.

27. How would the four materials described above be ranked as to **permeability**?

___ 1. In reverse order of the ranking above
___ 2. In the same order as the ranking above
___ 3. The four objects could not be ranked as they would have equal permeability
___ 4. Cannot be determined without more information

28. Which of the four materials would have the highest **magnetic flux**?

___ 1. Material A
___ 2. Material B
___ 3. Material C
___ 4. Material D

29. Which of the following are used both to control current flow **and** to convert energy into heat?

____ 1. resistors, capacitors and inductors

____ 2. resistors and capacitors

____ 3. inductors only

____ 4. resistors only

30. Which of the terms below does **not** belong with the other three?

____ 1. Impedance

____ 2. Resistance

____ 3. Reluctance

____ 4. Capacitance

31. In which of the following have the correct units of measure been used in the formula E = I x R?

____ 1. watts = volts x amperes

____ 2. amperes = ohms x watts

____ 3. ohms = volts x amperes

____ 4. volts = amperes x ohms

32. Assume that in each diagram below the law of charges is having an effect on the two figures within the rectangle. In which diagram will this effect be **greatest**?

____ 1.

____ 2.

____ 3.

____ 4.

33. Which of the following statements most correctly states the relationship between distance and the strength of magnetic force?

____ 1. increasing distance between the objects increases the affect

____ 2. increasing distance between the objects decreases the affect

____ 3. distance has more affect at some times than at others

____ 4. distance has no affect when objects are heated to certain temperatures

34. In a parallel circuit with several resistances, current flow is:

____ 1. equal in all conductors

____ 2. greatest in the conductor with greatest resistance

____ 3. least in the conductor with greatest resistance

____ 4. increased in proportion to total resistance

35. Current flow would be greatest in a:

____ 1. short wire of great thickness

____ 2. short wire of small thickness

____ 3. long wire of great thickness

____ 4. long wire of small thickness

36. Which of the following **BEST** describes the means by which electric current is obtained?

____ 1. regulating the movement of free electrons

____ 2. applying external energy through a conductor

____ 3. providing a source of resistance to the flow of electrons

____ 4. forcing electrons to break free of atoms

37. Each of the following can be explained by the principles of inductance **EXCEPT:**

____ 1. The transmission of power from one source to another by transformers

____ 2. Energy produced by power applied to one circuit is shared by a second circuit which is not physically connected to the power source

____ 3. Electrostatic energy from the dielectric of a capacitor is discharged when applied voltage is reduced

____ 4. Counter electromotive force is created in a circuit, thus slowing a decline in current level

38. Capacitance can be increased by each of the following **EXCEPT:**

____ 1. Increasing size of plates

____ 2. Increasing distance between plates

____ 3. Using dielectric material of less thickness

____ 4. Using dielectric material with better insulating qualities

39. In a circuit with capacitors, inductors, and resistors, total opposition to current flow is known as:

____ 1. reactance

____ 2. impedance

____ 3. ohmic value

____ 4. current lag

40. The relationship between the windings of primary and secondary transformer coils is known as the:

____ 1. voltage ratio

____ 2. current ratio

____ 3. turns ratio

____ 4. phase ratio

41. Which of the following describes the amount of AC current that effectively produces the same amount of energy as DC of equal value:

____ 1. peak value

____ 2. output current

____ 3. average value

____ 4. root mean square

42. Which device is used to regulate AC current by storing electrons?

___ 1. capacitors
___ 2. resistors
___ 3. inductors
___ 4. chokes

43. By making a change in one component of a simple circuit the total current was doubled. Which of the following **best** explains this change?

___ 1. The conductor length was doubled.
___ 2. The source voltage was doubled.
___ 3. An additional resistor was added to the circuit.
___ 4. The circuit was changed from series to parallel connection.

44. The plug contacts on an electric appliance which had been used for many years have become burned which increases the circuit resistance. Which of the following statements is the **most likely** result of this situation?

___ 1. The operation of the appliance will be unaffected since the wattage will not change.
___ 2. The cost of operating the appliance will be increased because the wattage.
___ 3. The appliance will be damaged by excess current flow.
___ 4. The appliance will not receive enough current for proper operation.

45. A circuit which has 20 ohms resistance is connected to a 120 volts energy source. Current in this circuit is:

___ 1. .16 ampere
___ 2. 6 amperes
___ 3. 24 amperes
___ 4. 240 amperes

46. In the circuit described in question 45, what power is dissipated?

___ 1. 6 watts
___ 2. 60 watts
___ 3. 240 watts
___ 4. 720 watts

47. How much power will be dissipated by a current of 2 amperes flowing through a conductor with resistance of 5 ohms?

___ 1. 5 watts
___ 2. 10 watts
___ 3. 20 watts
___ 4. 50 watts

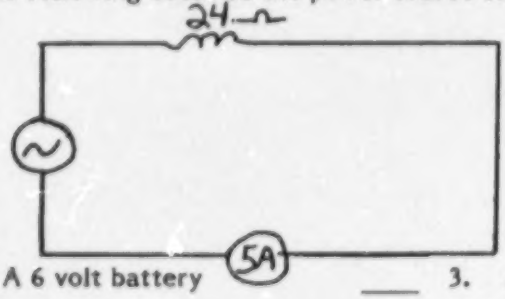
48. In order for a circuit with 20 ohms of resistance to carry 4 amperes of current, what voltage must be applied?

___ 1. 5 volts
___ 2. 50 volts
___ 3. 80 volts
___ 4. 85 volts

49. If current flow in a circuit is 30 amperes and voltage is reduced by 1/2, the current flow will:

___ 1. increase to 60 amperes
___ 2. increase to 45 amperes
___ 3. remain at 30 amperes
___ 4. decrease to 15 amperes

50. Which of the following could be the power source for the given circuit?



___ 1. A 6 volt battery
___ 2. Two 12 volt batteries
___ 3. An outlet supplying 120 volts
___ 4. An outlet supplying 240 volts

51. A 12 volt appliance draws 3 amperes of current. Its resistance is:

___ 1. 3.6 ohms
___ 2. 4 ohms
___ 3. 36 ohms
___ 4. 40 ohms

52. What power is consumed by the circuit described in question 51?

___ 1. 36 watts
___ 2. 48 watts
___ 3. 108 watts
___ 4. 480 watts

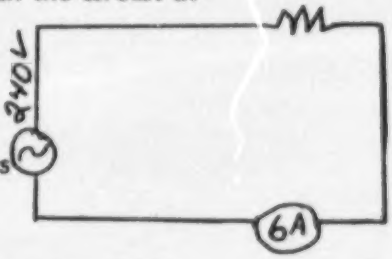
53. What would be the wattage rating on a lamp which has .5 amperes of current flowing through the filament with 120 applied volts?

____ 1. 60 watts
____ 2. 120 watts
____ 3. 240 watts
____ 4. 480 watts

54. How many ohms of resistance are required in a circuit to obtain 2 amperes of current with a 10 volt power supply?

____ 1. .2 ohms
____ 2. 2.5 ohms
____ 3. 5 ohms
____ 4. 20 ohms

55. What would be the value, in ohms, of the resistor pictured in the circuit at right?



____ 1. .04 ohms
____ 2. 4 ohms
____ 3. 40 ohms
____ 4. 144 ohms

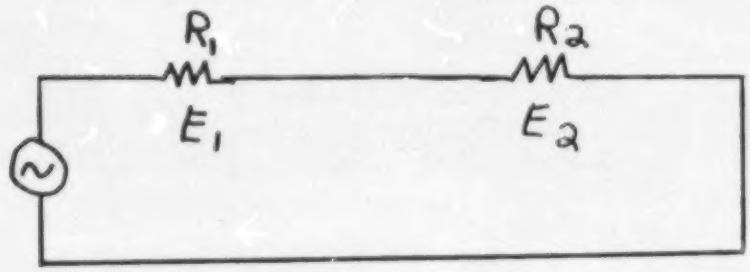
56. A 120 volt portable electric heater has a 600 watt setting. The current at that setting would be:

____ 1. .35 ampere
____ 2. 5 amperes
____ 3. 50 amperes
____ 4. 350 amperes

57. A 1450 watt, 120 volt AC heater would have to be on a circuit rated at or above which of the following?

____ 1. 10 amperes
____ 2. 15 amperes
____ 3. 20 amperes
____ 4. 30 amperes

Questions 58 - 61 all refer to the following schematic.



58. With 120 volts applied , if the current across R_1 = 2 amperes and R_2 = 40 ohms, what is the current across R_2?

____ 1. 1 ampere
____ 2. 2 amperes
____ 3. 3 amperes
____ 4. not enough information to determine

59. If R_1 = 20 ohms, E_1 = 80 volts, R_2 = 40 ohms, E_2 = 160 volts, what is total current in the circuit?

____ 1. not enough information to determine
____ 2. 4 amperes
____ 3. 8 amperes
____ 4. 12 amperes

60. If R_1 = 15 ohms, R_2 = 5 and applied voltage is 120 volts, what is I_T in the circuit?

____ 1. 6 amperes
____ 2. 8 amperes
____ 3. 24 amperes
____ 4. 32 amperes

61. In the given circuit, if R_1 = 8 ohms and R_2 = 20 ohms, R_T will equal:

____ 1. 5.7 ohms
____ 2. 14 ohms
____ 3. 28 ohms
____ 4. 160 ohms

62. 3 ohms, 4 ohms, and 9 ohms are connected in series with 64 volts applied. Which of the following is true?

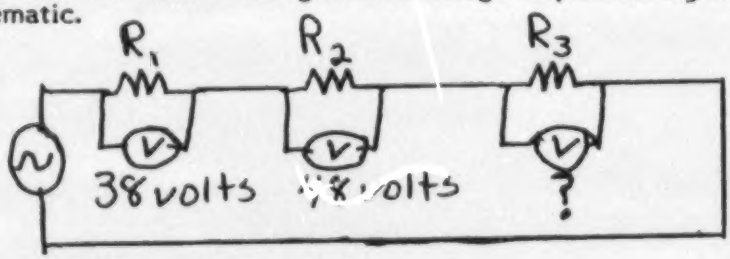
____ 1. 12 volts, 16 volts, and 36 volts are the respective voltage drops.

____ 2. Voltage drop across the 3 and 4 ohm resistors is equal to 30 volts.

____ 3. The smallest resistor will always have the largest voltage drop.

____ 4. Voltage drops can be determined only after current is determined.

63. Determine the meter reading for the voltage drop across R_3 in the given schematic.



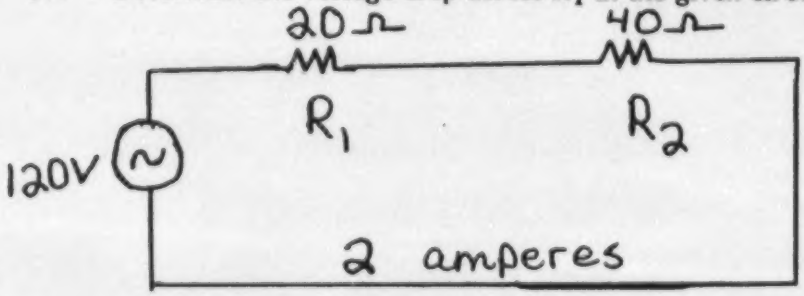
____ 1. 34 volts

____ 2. 38 volts

____ 3. 43 volts

____ 4. 48 volts

64. Determine the voltage drop across R_1 in the given circuit.



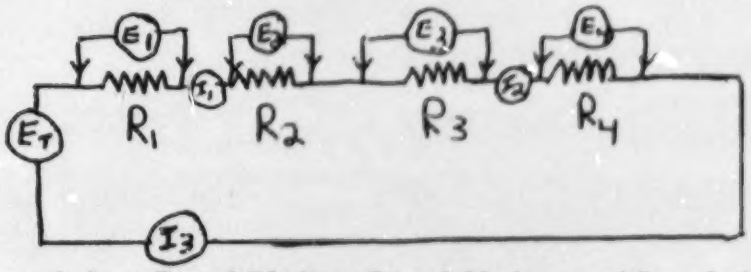
____ 1. 40 volts

____ 2. 60 volts

____ 3. 80 volts

____ 4. 120 volts

Question 65 - 68 all refer to the following schematic.



65. If R_1 = 6 ohms, R_2 = 3.75 ohms, R_3 = 2.25 ohms, and R_4 = 3 ohms with 30 volts applied then I_1 is:

____ 1. 2 amperes
____ 2. approximately 3 amperes
____ 3. 5 amperes
____ 4. 7 amperes

66. If R_1 = 6 ohms, R_2 = 3.75 ohms, R_3 = 3 ohms, and R_4 = 2.25 ohms with 30 volts applied, then I_T is:

____ 1. 2 amperes
____ 2. 2.14 amperes
____ 3. 5 amperes
____ 4. 7 amperes

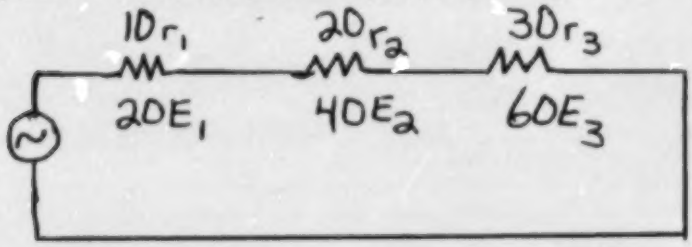
67. If R_1 = 3 ohms, R_2 = 1.875 ohms, R_3 = 1.125 ohms, and R_4 = 1.5 ohms then R_T is:

____ 1. 1.875 ohms
____ 2. approximately 3 ohms
____ 3. 6 ohms
____ 4. 7.5 ohms

68. If E_1 = 6 volts, E_2 = 3 volts, E_3 = 2.25 volts, and E_4 = 3.75 volts, then E_T equals:

____ 1. 6 volts
____ 2. 6.09 volts
____ 3. 14 volts
____ 4. 15 volts

Question 69 and 70 both refer to the following schematic.



69. Determine source voltage in the given circuit.

___ 1. cannot determine without more information
___ 2. 30 volts
___ 3. 60 volts
___ 4. 120 volts

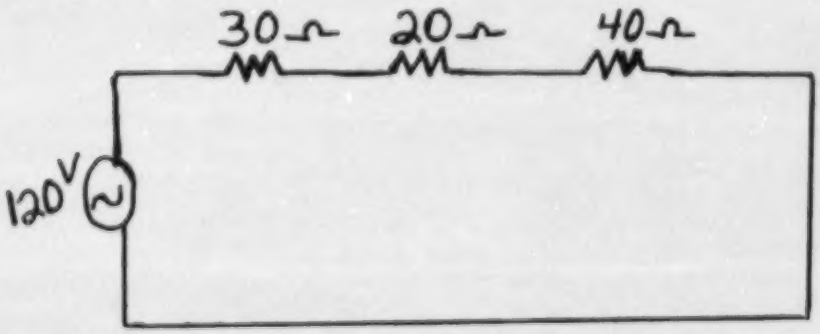
70. In the given circuit, R_T =

___ 1. 6.3 ohms
___ 2. 20 ohms
___ 3. 60 ohms
___ 4. 180 ohms

71. Five 25 ohm resistors in series would give a total resistance of:

___ 1. 5 ohms
___ 2. 25 ohms
___ 3. 125 ohms
___ 4. 250 ohms

72. Determine the total resistance from the given circuit.



___ 1. 10 ohms
___ 2. 30 ohms
___ 3. 60 ohms
___ 4. 90 ohms

Use this schematic for questions 73 - 76.

73. In the given circuit, if applied voltage is 120 volts, R_1 = 20 ohms, and R_2 = 30 ohms, what is the total current?

___ 1. 2.4 amperes
___ 2. 10 amperes
___ 3. 12 amperes
___ 4. 120 amperes

74. In the given circuit, if E_T = 150 volts, R_1 = 20 ohms and R_2 = 30 ohms, determine the current through R_2.

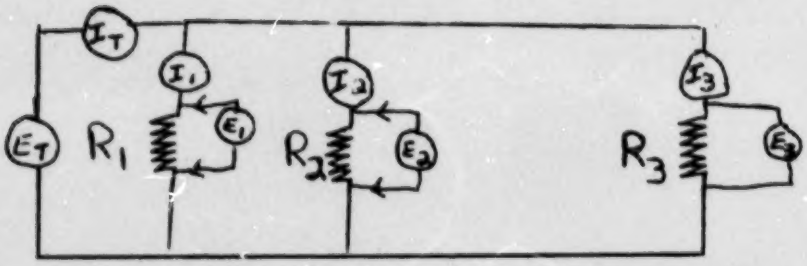
___ 1. 3 amperes
___ 2. 5 amperes
___ 3. 6 amperes
___ 4. 12.5 amperes

75. If 3 amperes of current flow across R_1 and there is a voltage drop of 120 volts across R_2, what is the voltage drop across R_1?

___ 1. not enough information to determine
___ 2. 120 volts
___ 3. 240 volts
___ 4. 360 volts

76. Determine total resistance in the given circuit if R_1 = 10 ohms and R_2 = 30 ohms.

___ 1. 3 ohms
___ 2. 7.5 ohms
___ 3. 20 ohms
___ 4. 40 ohms



Use this schematic for questions 77 - 80.

77. In the circuit, if E_T = 100 volts, R_T = 10 ohms and I_1 = 4 amperes, then I_3 is equal to:

____ 1. not enough information to determine

____ 2. 4 amperes

____ 3. 6 amperes

____ 4. 10 amperes

78. In the circuit, if R_T = 3 ohms, I_1 = 6 amperes, I_2 = 3 amperes, and I_3 = 1 ampere, what is the total circuit current?

____ 1. not enough information to determine

____ 2. 3.3 amperes

____ 3. 10 amperes

____ 4. 30 amperes

79. If R_1 = 6 ohms, I_1 = 4 amperes and R_T = 2 ohms, then E_T equals:

____ 1. 8 volts

____ 2. 16 volts

____ 3. 24 volts

____ 4. none of these

80. Determine total resistance in the given circuit if I_T = 10 amperes, R_1 = 5 ohms, R_2 = 10 ohms, and R_3 = 30 ohms.

____ 1. 3 ohms

____ 2. 4.5 ohms

____ 3. 33.3 ohms

____ 4. 45 ohms

81. In a circuit three 6 ohms resistors are connected in parallel across 120 volts. The total resistance in this circuit is equal to:

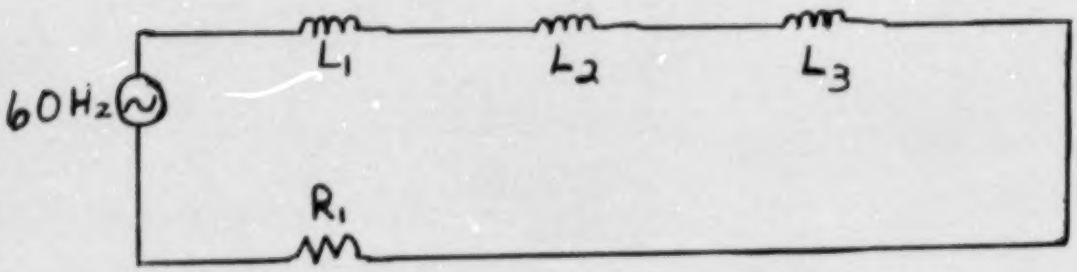
____ 1. 2 ohms

____ 2. 6 ohms

____ 3. 12 ohms

____ 4. 18 ohms

Questions 82 and 83 both refer to the following schematic:



82. Calculate total inductance from the given circuit if L_1 = 20 henry, L_2 = 30 henry, L_3 = 60 henry and R_1 = 5 ohms.

___ 1. 10 henry
___ 2. 35 henry
___ 3. 110 henry
___ 4. 115 henry

83. If in the given circuit resistance is equal to 4 ohms and inductive reactance is equal to 3 ohms then circuit impedance is equal to:

___ 1. 1.7 ohms
___ 2. 5 ohms
___ 3. 7 ohms
___ 4. 12 ohms

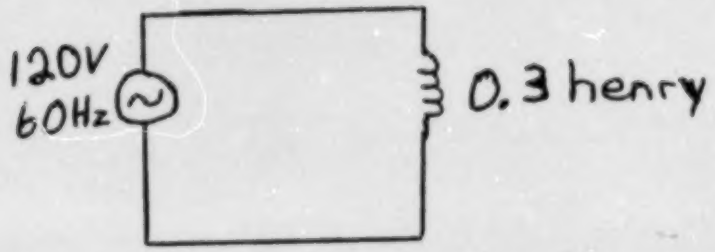
84. Two inductors of .6 henrys are connected in series. Total inductance would be:

___ 1. .3 henry
___ 2. .36 henry
___ 3. .6 henry
___ 4. 1.2 henrys

85. Two 10 henry inductors are connected in parallel with a 100 ohm resistor. In this circuit, total inductance will be:

___ 1. 5 henrys
___ 2. 10 henrys
___ 3. 20 henrys
___ 4. 110 henrys

86. Determine inductive reactance from the given circuit.



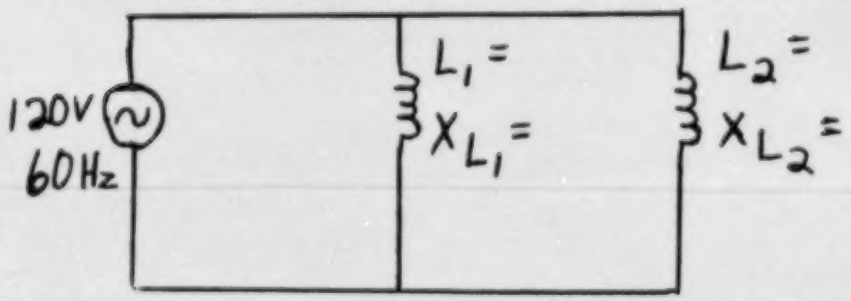
___ 1. 18 ohms

___ 2. 113 ohms

___ 3. 147ohms

___ 4. 180 ohms

Questions 87 and 88 both refer to the following schematic:



87. In the given circuit, if L_1 = 8 henrys and L_2 = 8 henrys, total inductance would be equal to:

___ 1. 4 henrys

___ 2. 8 henrys

___ 3. 16 henrys

___ 4. 64 henrys

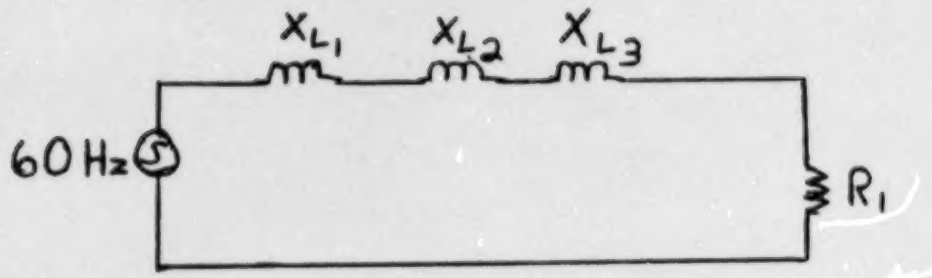
88. If X_{L_1} = 5 ohms and X_{L_2} = 20 ohms, inductive reactance would be equal to:

___ 1. 4 ohms

___ 2. 25 ohms

___ 3. 100 ohms

___ 4. 9420 ohms



Questions 89 and 90 both refer to the schematic pictured above.

89. If X_{L_1} = 5 ohms, X_{L_2} = 10 ohms, X_{L_3} = 15 ohms and R_1 = 30 ohms total inductive reactance in the given circuit is equal to:

___ 1. 2.5 ohms
___ 2. 2.73 ohms
___ 3. 30 ohms
___ 4. 60 ohms

90. If total inductive reactance in the given circuit is equal to 8 ohms, and R_1 is equal to 6 ohms, impedance is equal to:

___ 1. 3.4 ohms
___ 2. 10 ohms
___ 3. 14 ohms
___ 4. 3014 ohms

91. What voltage is required in a 60 hz circuit with inductive reactance of 60 ohms, resistance of 40 ohms and impedance of 72 ohms in order to obtain 5 amperes of flow?

___ 1. 200 volts
___ 2. 300 volts
___ 3. 360 volts
___ 4. 860 volts

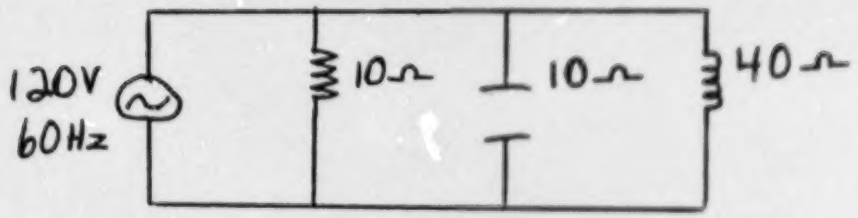
92. A 120V 60 hz circuit with inductive reactance of 25 ohms, resistance of 10 ohms, and impedance of 27 ohms would carry a current flow of:

___ 1. 1.9 amperes
___ 2. 3.4 amperes
___ 3. 4.4 amperes
___ 4. 12 amperes

93. With 120 volts, 60 hz applied to a parallel circuit containing 10 ohms of resistance, 10 ohms X_1, and 40 ohms X_C, what is total impedance?

___ 1. 8 ohms
___ 2. 10 ohms
___ 3. 21.7 ohms
___ 4. 40 ohms

94. Determine impedance from the given circuit.



___ 1. 8 ohms

___ 2. 10 ohms

___ 3. 40 ohms

___ 4. 60 ohms

95. A 6.6 microfarad capacitor with capacitive reactance of 402.11 ohms is connected in series with a 200 ohms resistor and an inductor with 400 ohms inductive reactance. If applied voltage is 200 volts at 60 hz, then current flow will be approximately:

___ 1. 0.2 amperes

___ 2. 0.35 amperes

___ 3. 0.5 amperes

___ 4. 1 ampere

96. A series circuit containing a 30 ohm resistor, inductive reactance of 210 ohms, and capacitive reactance of 250 ohms has a 200 volts power source. What is the current flow in this circuit?

___ 1. .88 amperes

___ 2. 1 ampere

___ 3. 4.4 amperes

___ 4. 7.3 amperes

FORM B

ELECTRICITY

STUDENT NAME: _____

TEACHER NAME: _____

CLASS: _____

DATE: _____

Directions: The two columns below contain descriptions of properties of electrical circuits and their basic unit of measurement for questions 1 - 6. You are to match each description from Column A with the proper unit of measure in Column B. Choices in Column B may be used once, more than once, or not at all. Remember to record your answer by placing an "X" in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

		Column A		Column B
____	1.	inductance	1)	ohm
____	2.	resistance	2)	coulomb
____	3.	capacitive reactance	3)	farad
____	4.	AC frequency	4)	henry
____	5.	inductive reactance	5)	hertz
____	6.	capacitance		

Directions: The two columns below contain descriptions of properties of electrical circuits and their basic unit of measurement for questions 7 - 11. You are to match each description from Column A with the proper unit of measure in Column B. Choices in Column B may be used once, more than once, or not at all. Remember to record your answer by placing an "X" in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

		Column A		Column B
____	7.	electric power	1)	ampere
____	8.	electromotive force	2)	volt
____	9.	capacitive reactance	3)	watt
____	10.	applied electrical pressure	4)	ohm
____	11.	current	5)	farad

Directions: For questions 12 - 16, read each statement from Column A and choose from Column B the meter being described. Choices from Column B may be used once, more than once, or not at all. Remember to record your answer by placing an "X" in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

		Column A		Column B
____	12.	Must always be connected in series	1)	ammeter
			2)	ohmmeter
____	13.	Measures electrical pressure	3)	voltmeter
____	14.	Measures amount of current in a circuit	4)	wattmeter
____	15.	Should never be used on a device which has power applied		
____	16.	A multiplier is used to increase measurement range		

Listed below are 6 statements with accompanying conditions. You are to read each statement and condition and respond according to the following key:

Mark:

1 - the statement is true if the condition applies
2 - the statement is true regardless of the condition
3 - the statement is false if the condition applies
4 - the statement is false regardless of the condition
5 - it is impossible to determine without more information

Remember to record your answer by placing an **"X"** in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

		Statement	Condition
17.	____	The direction of the flow of electrons through a conductor is irreversible, even	if the charges on the terminals are reversed
18.	____	Two charges objects repel each other	if both attract similarly charged objects
19.	____	In a circuit electrons move along one path only	if the circuit is connected in series
20.	____	Increasing the number of amperes in an electromagnet will increase the strength of the magnetic field	if the electromagnet has an iron core
21.	____	Increasing the number of turns in a coil will decrease the strength of an electromagnet	if the electron is toward the northern polarity
22.	____	As the intensity of current flow increases, ammeter deflection increases proportionately	if the ammeter is set on a linear scale

Directions: Questions 23 through 102 are all multiple choice items. You are to respond by choosing the **ONE** alternative which **BEST** answers the question or completes the statement. Remember to record your answer by placing an **"X"** in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet. Some of the items require you to use some math to figure the answers. For these items, you may use any blank space in the margins of the test booklet for your calculations.

23. The value of which of the following units of measure should be substituted for the "f" in the formula $X_C = \frac{1}{2\pi fC}$?

____ 1. henrys
____ 2. hertz
____ 3. farads
____ 4. ohms

24. The value of which of the following units of measure should be substituted for the "C" in the formula $X_C = \frac{1}{2\pi fC}$?

___ 1. henrys
___ 2. hertz
___ 3. farads
___ 4. ohms

25. The value of which of the following units of measure should be substituted for the "L" in the formula $X_L = 2\pi fL$?

___ 1. henrys
___ 2. hertz
___ 3. farads
___ 4. ohms

26. The value of which of the following units of measure should be substituted for the "Z" in the formula I = E/Z?

___ 1. henrys
___ 2. hertz
___ 3. farads
___ 4. ohms

Questions 27 and 28 both refer to the following information:

Four different materials are ranked as to their ability to become magnetized.
Material A is ranked #1, or highest ability to become magnetized.
Material B is ranked #2, or second highest ability to become magnetized.
Material C is ranked #3, or third highest ability to become magnetized.
Material D is ranked #4, or least ability to become magnetized.

27. How would the four materials described above be ranked as to **permeability**?

___ 1. In reverse order of the ranking above
___ 2. In the same order as the ranking above
___ 3. The four objects could not be ranked as they would have equal permeability
___ 4. Cannot be determined without more information

28. Which of the four materials would have the highest **magnetic flux**?

___ 1. Material A
___ 2. Material B
___ 3. Material C
___ 4. Material D

29. Which of the following are used both to control current flow **and** to convert energy into heat?

____ 1. resistors, capacitors and inductors

____ 2. resistors and capacitors

____ 3. inductors only

____ 4. resistors only

30. Which of the terms below does **not** belong with the other three?

____ 1. Impedance

____ 2. Resistance

____ 3. Reluctance

____ 4. Capacitance

31. In which of the following have the correct units of measure been used in the formula E = I x R?

____ 1. watts = volts x amperes

____ 2. amperes = ohms x watts

____ 2. ohms = volts x amperes

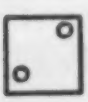
____ 4. volts = amperes x ohms

32. Assume that in each diagram below the law of charges is having an effect on the two figures within the rectangle. In which diagram will this effect be **greatest?**

____ 1.

____ 2.

____ 3.

____ 4. 

33. Which of the following statements most correctly states the relationship between distance and the strength of magnetic force?

____ 1. increasing distance between the objects increases the affect

____ 2. increasing distance between the objects decreases the affect

____ 3. distance has more affect at some times than at others

____ 4. distance has no affect when objects are heated to certain temperatures

34. In a parallel circuit with several resistances, current flow is:

____ 1. equal in all conductors

____ 2. greatest in the conductor with greatest resistance

____ 3. least in the conductor with greatest resistance

____ 4. increased in proportion to total resistance

35. Current flow would be greatest in a:

____ 1. short wire of great thickness

____ 2. short wire of small thickness

____ 3. long wire of great thickness

____ 4. long wire of small thickness

30. Which of the following **BEST** describes the means by which electric current is obtained?

____ 1. regulating the movement of free electrons

____ 2. applying external energy through a conductor

____ 3. providing a source of resistance to the flow of electrons

____ 4. forcing electrons to break free of atoms

37. Each of the following can be explained by the principles of inductance **EXCEPT:**

____ 1. The transmission of power from one source to another by transformers

____ 2. Energy produced by power applied to one circuit is shared by a second circuit which is not physically connected to the power source

____ 3. Electrostatic energy from the dielectric of a capacitor is discharged when applied voltage is reduced

____ 4. Counter electromotive force is created in a circuit, thus slowing a decline in current level

38. Capacitance can be increased by each of the following **EXCEPT:**

____ 1. Increasing size of plates

____ 2. Increasing distance between plates

____ 3. Using dielectric material of less thickness

____ 4. Using dielectric material with better insulating qualities

39. In a circuit with capacitors, inductors, and resistors, total opposition to current flow is known as:

____ 1. reactance

____ 2. impedance

____ 3. ohmic value

____ 4. current lag

40. The relationship between the windings of primary and secondary transformer coils is known as the:

____ 1. voltage ratio

____ 2. current ratio

____ 3. turns ratio

____ 4. phase ratio

41. Which of the following describes the amount of AC current that effectively produces the same amount of energy as DC of equal value:

____ 1. peak value

____ 2. output current

____ 3. average value

____ 4. root mean square

42. Which device is used to regulate AC current by storing electrons?

___ 1. capacitors
___ 2. resistors
___ 3. inductors
___ 4. chokes

43. By making a change in one component of a simple circuit the total current was doubled. Which of the following **best** explains this change?

___ 1. The conductor length was doubled.
___ 2. The source voltage was doubled.
___ 3. An additional resistor was added to the circuit.
___ 4. The circuit was changed from series to parallel connection.

44. The plug contacts on an electric appliance which had been used for many years have become burned which increases the circuit resistance. Which of the following statements is the **most likely** result of this situation?

___ 1. The operation of the appliance will be unaffected since the wattage will not change.
___ 2. The cost of operating the appliance will be increased because the wattage.
___ 3. The appliance will be damaged by excess current flow.
___ 4. The appliance will not receive enough current for proper operation.

45. A circuit which has 20 ohms resistance is connected to a 120 volts energy source. Current in this circuit is:

___ 1. .16 ampere
___ 2. 6 amperes
___ 3. 24 amperes
___ 4. 240 amperes

46. In the circuit described in question 45, what power is dissipated?

___ 1. 6 watts
___ 2. 60 watts
___ 3. 240 watts
___ 4. 720 watts

47. How much power will be dissipated by a current of 2 amperes flowing through a conductor with resistance of 5 ohms?

___ 1. 5 watts
___ 2. 10 watts
___ 3. 20 watts
___ 4. 50 watts

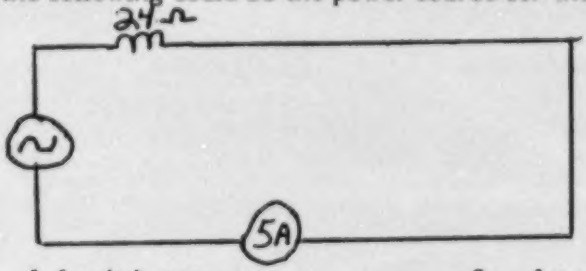
48. In order for a circuit with 20 ohms of resistance to carry 4 amperes of current, what voltage must be applied?

___ 1. 5 volts
___ 2. 50 volts
___ 3. 80 volts
___ 4. 85 volts

49. If current flow in a circuit is 30 amperes and voltage is reduced by 1/2, the current flow will:

___ 1. increase to 60 amperes
___ 2. increase to 45 amperes
___ 3. remain at 30 amperes
___ 4. decrease to 15 amperes

50. Which of the following could be the power source for the given circuit?



___ 1. A 6 volt battery
___ 2. Two 12 volt batteries
___ 3. An outlet supplying 120 volts
___ 4. An outlet supplying 240 volts

51. A 12 volt appliance draws 3 amperes of current. Its resistance is:

___ 1. 3.6 ohms
___ 2. 4 ohms
___ 3. 36 ohms
___ 4. 40 ohms

52. What power is consumed by the circuit described in question 51?

___ 1. 36 watts
___ 2. 48 watts
___ 3. 108 watts
___ 4. 480 watts

53. What would be the wattage rating on a lamp which has .5 amperes of current flowing through the filament with 120 applied volts?

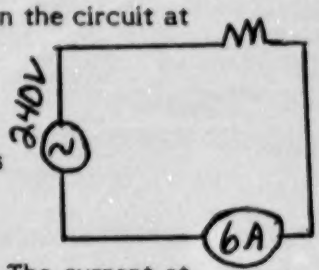
___ 1. 60 watts
___ 2. 120 watts
___ 3. 240 watts
___ 4. 480 watts

54. How many ohms of resistance are required in a circuit to obtain 2 amperes of current with a 10 volt power supply?

___ 1. .2 ohms
___ 2. 2.5 ohms
___ 3. 5 ohms
___ 4. 20 ohms

55. What would be the value, in ohms, of the resistor pictured in the circuit at right?

___ 1. .04 ohms
___ 2. 4 ohms
___ 3. 40 ohms
___ 4. 144 ohms



56. A 120 volt portable electric heater has a 600 watt setting. The current at that setting would be:

___ 1. .35 ampere
___ 2. 5 amperes
___ 3. 50 amperes
___ 4. 350 amperes

57. A 1450 watt, 120 volt AC heater would have to be a circuit rated at or above which of the following?

___ 1. 10 amperes
___ 2. 15 amperes
___ 3. 20 amperes
___ 4. 30 amperes

58. A resistor is color coded orange, blue, brown. What is the value of this resistor in ohms?

___ 1. 36 ohms
___ 2. 360 ohms
___ 3. 361 ohms
___ 4. 3610 ohms

59. The tolerance of the resistor described in question 58 would be:

___ 1. cannot be determined without more information
___ 2. ± 5%
___ 3. ± 10%
___ 4. ± 20%

60. For a circuit requiring 5 ohms of resistance, you would use which of the following resistors?

____ 1. Black, Black, Green

____ 2. Black, Green, Black

____ 3. Green, Black, Silver

____ 4. Green, Black, Gold

61. 430 actual ohms of resistance can be obtained from each of the following **EXCEPT:**

____ 1. A 400 ohm resistor with no fourth band.

____ 2. A 400 ohm resistor with a silver fourth band.

____ 3. A 500 ohm resistor with no fourth band.

____ 4. A 500 ohm resistor with a silver fourth band.

62. A resistor coded with three bands of white, white, silver will supply:

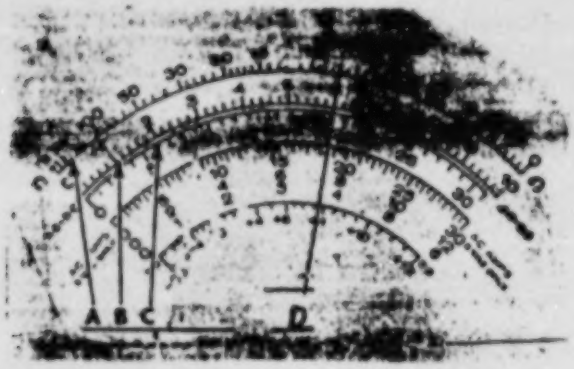
____ 1. approximately 10 ohms of resistance.

____ 2. 99 ohms of resistance.

____ 3. less than 2 ohms at its high range.

____ 4. a minimum of 1 ohm at its low range.

Questions 63 - 65 all refer to the figure below.



63. In the figure above which indicated readings should be shifted to another range for accuracy?

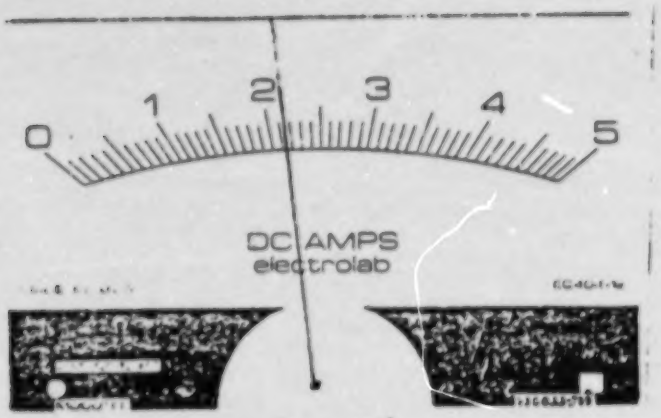
___ 1. C and D
___ 2. A and B
___ 3. A and D
___ 4. All of them

64. If the voltage range switch is set on 1000V AC, what is the voltage reading, pointer D?

___ 1. 60 volts AC
___ 2. 190 volts AC
___ 3. 600 volts AC
___ 4. 600 volts DC

65. With the range switch set on R x 10K, what is the reading of pointer D?

___ 1. 8 ohms
___ 2. 8,000 ohms
___ 3. 68,000 ohms
___ 4. 80,000 ohms



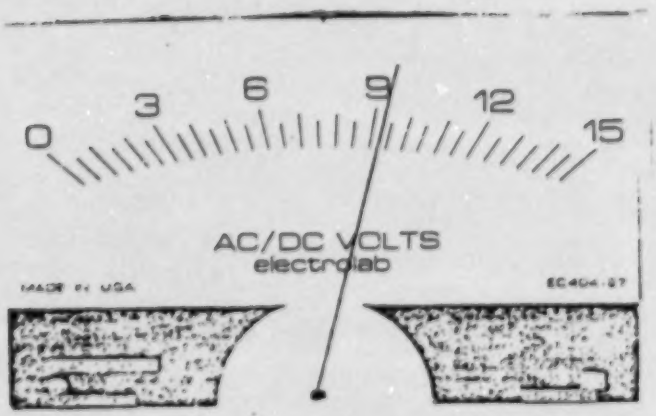
66. The meter above is reading:

___ 1. 2.15 amperes DC

___ 2. 21.5 amperes DC

___ 3. 21.5 amperes AC

___ 4. 2.15 amperes AC



67. This meter is reading, on DC selection:

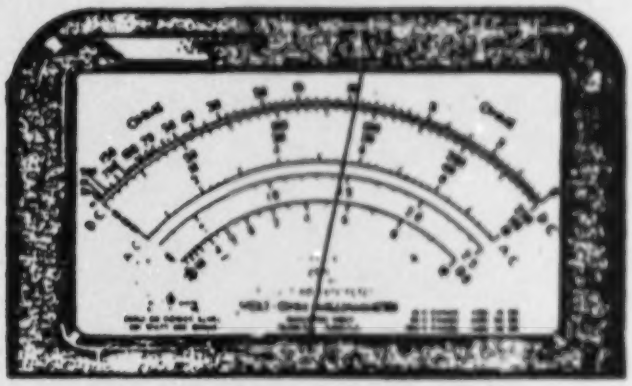
___ 1. 9.5 volts DC

___ 2. 9.4 volts DC

___ 3. 9.25 volts DC

___ 4. 9.1 volts DC

68. Determine the correct reading from the given meter indication.



Function Switch + DC
Range Switch 100 MA

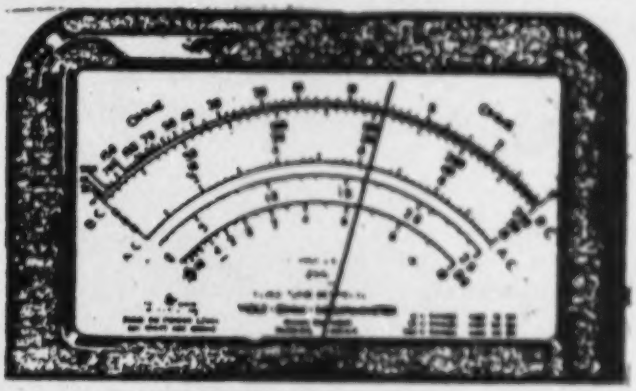
___ 1. 9mA

___ 2. 28mA

___ 3. 56mA

___ 4. 240mA

69. Determine the correct reading from the given meter indication.



Function Switch + DC
Range Switch RX 10,000

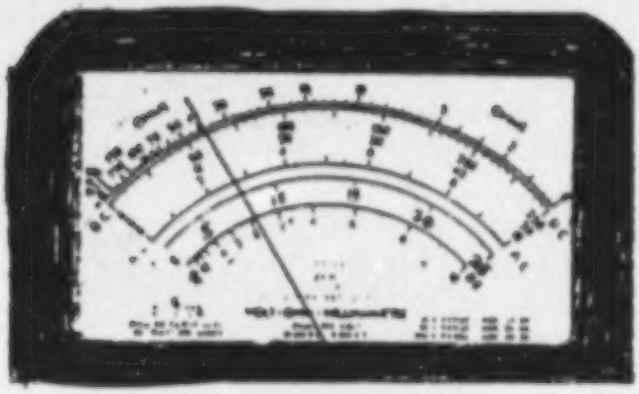
___ 1. 155 ohms

___ 2. 1,550 ohms

___ 3. 7,500 ohms

___ 4. 75,000 ohms

70. Determine the correct reading from the given meter indication.



Function Switch ⏚ DC
Range Switch 2.5V

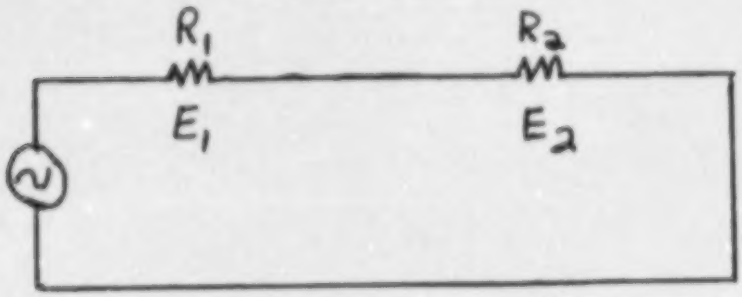
___ 1. .4 volt

___ 2. .6 volt

___ 3. 40 volts

___ 4. 60 volts

Questions 71 - 74 all refer to the following schematic.



71. With 120 volts applied , if the current across R_1 = 2 amperes and R_2 = 40 ohms, what is the current across R_2?

___ 1. 1 ampere
___ 2. 2 amperes
___ 3. 3 amperes
___ 4. not enough information to determine

72. If R_1 = 20 ohms, E_1 = 80 volts, R_2 = 40 ohms, E_2 = 160 volts, what is total current in the circuit?

___ 1. not enough information to determine
___ 2. 4 amperes
___ 3. 8 amperes
___ 4. 12 amperes

73. If R_1 = 15 ohms, R_2 = 5 ohms and applied voltage is 120 volts, what is I_T in the circuit?

___ 1. 6 amperes
___ 2. 8 amperes
___ 3. 24 amperes
___ 4. 32 amperes

74. In the given circuit, if R_1 = 8 ohms and R_2 = 20 ohms, R_T will equal:

___ 1. 5.7 ohms
___ 2. 14 ohms
___ 3. 28 ohms
___ 4. 160 ohms

75. 3 ohms, 4 ohms, and 9 ohms are connected in series with 64 volts applied. Which of the following is true?

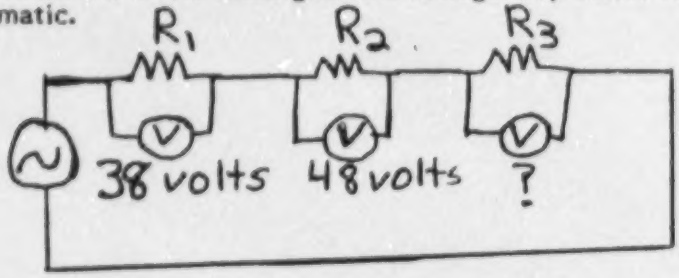
___ 1. 12 volts, 16 volts, and 36 volts are the respective voltage drops.

___ 2. Voltage drop across the 3 and 4 ohm resistors is equal to 30 volts.

___ 3. The smallest resistor will always have the largest voltage drop.

___ 4. Voltage drops can be determined only after current is determined.

76. Determine the meter reading for the voltage drop across R_3 in the given schematic.



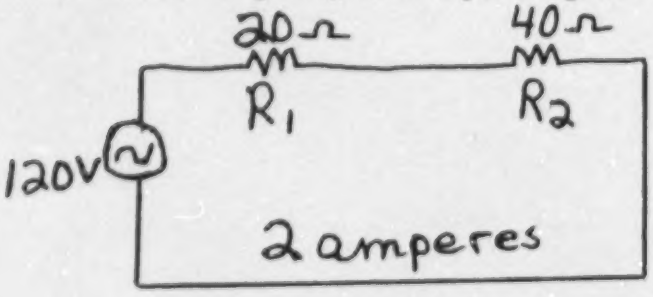
___ 1. 34 volts

___ 2. 38 volts

___ 3. 43 volts

___ 4. 48 volts

77. Determine the voltage drop across R_1 in the given circuit.



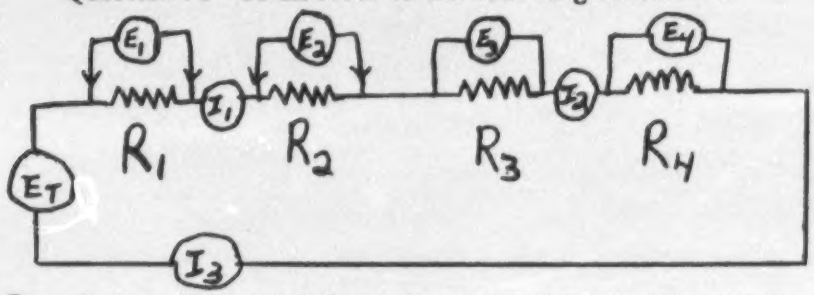
___ 1. 40 volts

___ 2. 60 volts

___ 3. 80 volts

___ 4. 120 volts

Question 78 - 81 all refer to the following schematic.



78. If R_1 = 6 ohms, R_2 = 3.75 ohms, R_3 = 2.25 ohms, and R_4 = 3 ohms with 30 volts applied then I_1 is:

____ 1. 2 amperes
____ 2. approximately 3 amperes
____ 3. 5 amperes
____ 4. 7 amperes

79. If R_1 = 6 ohms, R_2 = 3.75 ohms, R_3 = 3 ohms, and R_4 = 2.25 ohms with 30 volts applied, then I_T is:

____ 1. 2 amperes
____ 2. 2.14 amperes
____ 3. 5 amperes
____ 4. 7 amperes

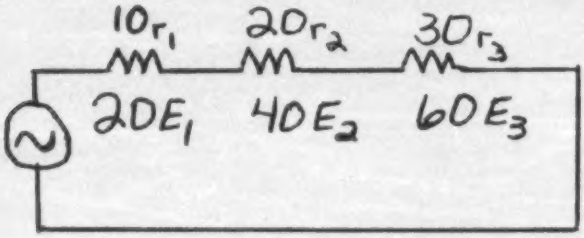
80. If R_1 = 3 ohms, R_2 = 1.875 ohms, R_3 = 1.125 ohms, and R_4 = 1.5 ohms then R_T is:

____ 1. 1.875 ohms
____ 2. approximately 3 ohms
____ 3. 6 ohms
____ 4. 7.5 ohms

81. If E_1 = 6 volts, E_2 = 3 volts, E_3 = 2.25 volts, and E_4 = 3.75 volts, then E_T equals:

____ 1. 14 volts
____ 2. 6.09 volts
____ 3. 6 volts
____ 4. 15 volts

Questions 82 and 83 both refer to the circuit below.



84. Determine source voltage in the given circuit.

___ 1. cannot determine without more information

___ 2. 30 volts

___ 3. 60 volts

___ 4. 120 volts

83. In the given circuit, R_T =

___ 1. 6.3 ohms

___ 2. 20 ohms

___ 3. 60 ohms

___ 4. 180 ohms

84. Five 25 ohm resistors in series would give a total resistance of:

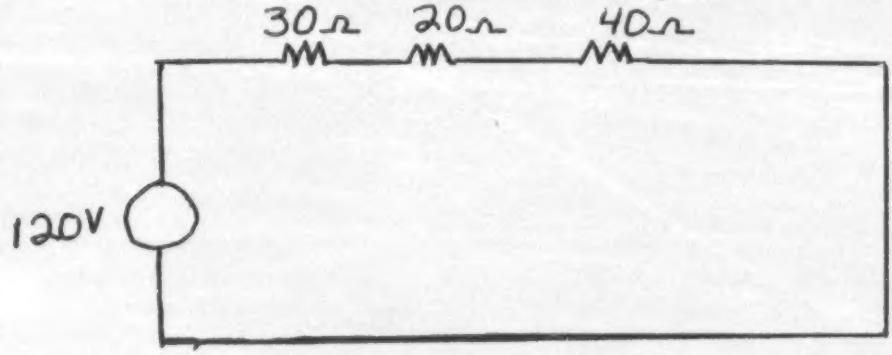
___ 1. 5 ohms

___ 2. 25 ohms

___ 3. 125 ohms

___ 4. 250 ohms

85. Determine the total resistance from the given circuit.



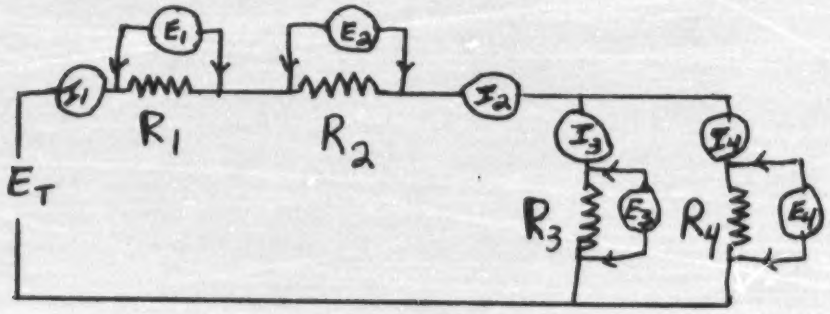
___ 1. 10 ohms

___ 2. 30 ohms

___ 3. 60 ohms

___ 4. 90 ohms

Ouestions 86 - 90 are all based on the following schematic.



86. If E_1 = 40 volts, E_2 = 60 volts, E_3 = 30 volts, and E_4 = 30 volts, then E_T is:

____ 1. 100 volts
____ 3. 130 volts
____ 2. 115 volts
____ 4. 160 volts

87. If E_1 = 10 volts, E_3 = 7.5 volts, E_4 = 7.5 volts, and E_T = 32.5 volts what is E_2 =

____ 1. 7.5 volts
____ 3. 15 volts
____ 2. 10 volts
____ 4. 25 volts

88. If E_T = 65 volts and R_T = 26 ohms, then I_T is:

____ 1. 25 amperes
____ 3. 2.5 amperes
____ 2. 12.5 amperes
____ 4. 1.25 amperes

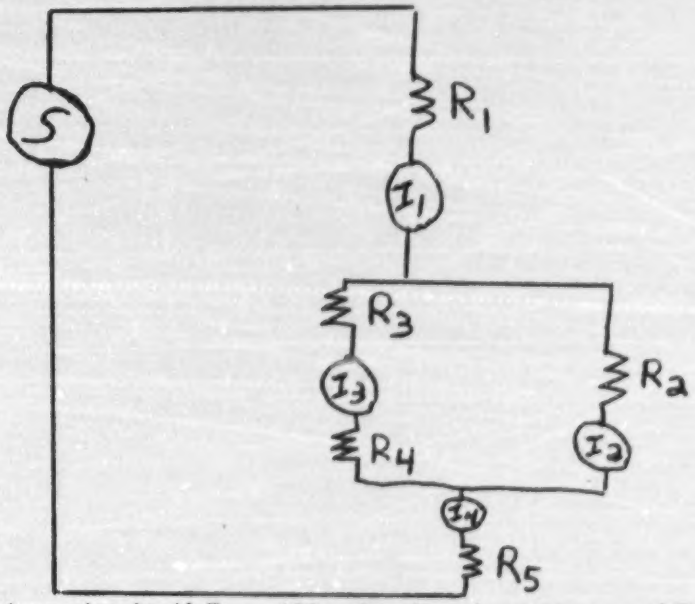
89. If current I_2 is 10 amperes, and I_3 is 4 amperes, then I_4 is:

____ 1. 4 amperes
____ 3. 6 amperes
____ 2. 5 amperes
____ 4. 10 amperes

90. If R_1 = 4 ohms, R_2 = 6 ohms, R_3 = 4 ohms, and R_4 = 12 ohms, then R_T =

____ 1. 13 ohms
____ 3. 18 ohms
____ 2. 16 ohms
____ 4. 26 ohms

Questions 91 - 93 are all based on the following schematic.



91. In the given circuit, if E_T = 100 volts, I_1 = 4 amperes, and R_2 = 20 ohms then I_2 is equal to:

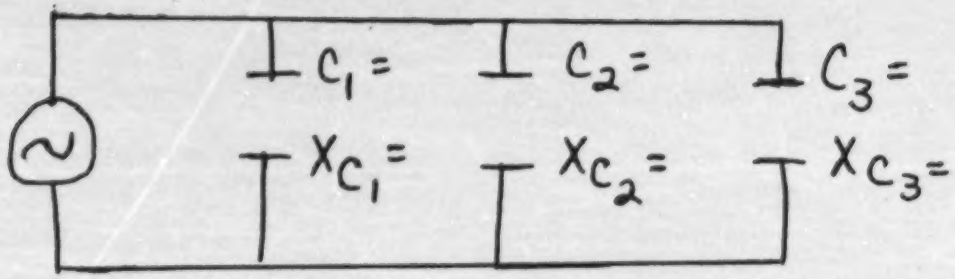
___ 1. 2 amperes
___ 2. 4 amperes
___ 3. 5 amperes
___ 4. not enough information to determine

92. If E_{R_1} = 20 volts, E_{R_3} = 20 volts, E_{R_4} = 20 volts and E_{R_5} = 40 volts, what is the voltage drop at resistor R_2?

___ 1. not enough information to determine
___ 2. 10 volts
___ 3. 20 volts
___ 4. 40 volts

93. If I_T = 8 amperes and R_1 = 3 ohms, R_2 = 10 ohms, R_3 = 5 ohms, R_4 = 5 ohms and R_5 = 5 ohms, determine the applied voltage in the circuit.

___ 1. 104 volts
___ 2. 144 volts
___ 3. 184 volts
___ 4. 225 volts



Questions 94 and 95 refer to the schematic pictured above.

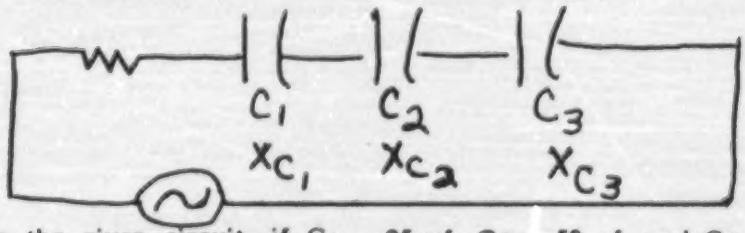
94. Calculate total capacitance from the given circuit if C_1 = 30 uf, C_2 = 30 uf, and C_3 = 30 uf.

___ 1. 10 uf
___ 2. 30 uf
___ 3. 90 uf
___ 4. 300 uf

95. If X_{C_1} = 100 ohms, X_{C_2} = 100 ohms, and X_{C_3} = 200 ohms, total capacitive reactance is equal to:

___ 1. 40 ohms
___ 2. 133.3 ohms
___ 3. 400 ohms
___ 4. 5000 ohms

Question 96 - 98 all refer to the schematic pictured below.



96. In the given circuit, if C_1 = 25 uf, C_2 = 50 uf, and C_3 = 25 uf, total capacitance is equal to:

___ 1. 10 uf
___ 2. 33.3 uf
___ 3. 100 uf
___ 4. 312.5 uf

97. If X_{C_1} = 10 ohms, X_{C_2} = 25 ohms and X_{C_3} = 5 ohms, and R = 5 ohms, capacitive reactance is equal to:

___ 1. 2.9 ohms
___ 2. 31.25 ohms
___ 3. 40 ohms
___ 4. 45 ohms

98. With total capacitive reactance of 20 ohms, resistance of 30 ohms, and voltage of 220V, 60 hz., what current will flow in the circuit.

___ 1. 4.4 amperes
___ 2. 6.1 amperes
___ 3. 11 amperes
___ 4. 12 amperes

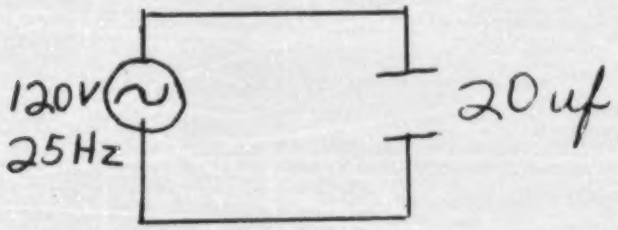
99. Two 30 microfarad capacitors are connected in series. C_T is equal to:

___ 1. 15 microfarads
___ 2. 30 microfarad
___ 3. 60 microfarads
___ 4. 900 microfarads

100. 10 microfarads, 20 microfarads, and 30 microfarads are hooked in parallel. C_T is equal to:

___ 1. 5.45 microfarads
___ 2. 18 microfarads
___ 3. 20 microfarads
___ 4. 60 microfarads

101. Determine capacitive reactance from the given circiuit.



___ 1. 165 ohms
___ 2. 318 ohms
___ 3. 416 ohms
___ 4. 3,140 ohms

102. What current will be obtained in a circuit with 300 ohms resistance, 400 ohms of capacitive reactance and impedance of 500 ohms, if applied voltage is 100V?

___ 1. .2 amperes
___ 2. .25 amperes
___ 3. 3 amperes
___ 4. not enough information to determine

FORM C

ELECTRICITY

STUDENT NAME: _____

TEACHER NAME: _____

CLASS: _____

DATE: _____

Directions: The two columns below contain descriptions of properties of electrical circuits and their basic unit of measurement for questions 1 - 6. You are to match each description from Column A with the proper unit of measure in Column B. Choices in Column B may be used once, more than once, or not at all. Remember to record your answer by placing an "X" in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

	Column A	Column B
____ 1.	inductance	1) ohm
____ 2.	resistance	2) coulomb
____ 3.	capacitive reactance	3) farad
____ 4.	AC frequency	4) henry
____ 5.	inductive reactance	5) hertz
____ 6.	capacitance	

Directions: The two columns below contain descriptions of properties of electrical circuits and their basic unit of measurement for questions 7 - 11. You are to match each description from Column A with the proper unit of measure in Column B. Choices in Column B may be used once, more than once, or not at all. Remember to record your answer by placing an "X" in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

	Column A	Column B
____ 7.	electric power	1) ampere
____ 8.	electromotive force	2) volt
____ 9.	capacitive reactance	3) watt
____ 10.	applied electrical pressure	4) ohm
____ 11.	current	5) farad

Directions: For questions 12 - 16 read each statement from Column A and choose from Column B the meter being described. Choices from Column B may be used once, more than once, or not at all. Remember to record your answer by placing an "X" in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

	Column A	Column B
____ 12.	Must always be connected in series	1) ammeter
____ 13.	Measures electrical pressure	2) ohmmeter
____ 14.	Measures amount of current in a circuit	3) voltmeter
____ 15.	Should never be used on a device which has power applied	4) wattmeter
____ 16.	A multiplier is used to increase measurement range	

Listed below are 6 statements with accompanying conditions. You are to read each statement and condition and respond according to the following key:

Mark:

1 - the statement is true if the condition applies
2 - the statement is true regardless of the condition
3 - the statement is false if the condition applies
4 - the statement is false regardless of the condition
5 - it is impossible to determine without more information

Remember to record your answer by placing an **"X"** in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet.

		Statement	Condition
17.	____	The direction of the flow of electrons through a conductor is irreversible, even	if the charges on the terminals are reversed
18.	____	Two charges objects repel each other	if both attract similarly charged objects
19.	____	In a circuit electrons move along one path only	if the circuit is connected in series
20.	____	Increasing the number of amperes in an electromagnet will increase the strength of the magnetic field	if the electromagnet has an iron core
21.	____	Increasing the number of turns in a coil will decrease the strength of an electromagnet	if the electron is toward the northern polarity
22.	____	As the intensity of current flow increases, ammeter deflection increases proportionately	if the ammeter is set on a linear scale

Directions: Questions 23 through 96 are all multiple choice items. You are to respond by choosing the **ONE** alternative which **BEST** answers the question or completes the statement. Remember to record your answer by placing an **"X"** in the blank beside the correct response **AND** by blackening in the appropriate circle on your answer sheet. Some of the items require you to use some math to figure the answers. For these items, you may use any blank space in the margins of the test booklet for your calculations.

23. The value of which of the following units of measure should be substituted for the "f" in the formula $X_C = \frac{1}{2\pi fC}$?

____ 1. henrys
____ 2. hertz
____ 3. farads
____ 4. ohms

24. The value of which of the following units of measure should be substituted for the "C" in the formula $X_C = \frac{1}{2\pi fC}$?

___ 1. henrys
___ 2. hertz
___ 3. farads
___ 4. ohms

25. The value of which of the following units of measure should be substituted for the "L" in the formula $X_L = 2\pi fL$?

___ 1. henrys
___ 2. hertz
___ 3. farads
___ 4. ohms

26. The value of which of the following units of measure should be substituted for the "Z" in the formula I = E/Z?

___ 1. henrys
___ 2. hertz
___ 3. farads
___ 4. ohms

Questions 27 and 28 both refer to the following information:

Four different materials are ranked as to their ability to become magnetized.
Material A is ranked #1, or highest ability to become magnetized.
Material B is ranked #2, or second highest ability to become magnetized.
Material C is ranked #3, or third highest ability to become magnetized.
Material D is ranked #4, or least ability to become magnetized.

27. How would the four materials described above be ranked as to **permeability**?

___ 1. In reverse order of the ranking above
___ 2. In the same order as the ranking above
___ 3. The four objects could not be ranked as they would have equal permeability
___ 4. Cannot be determined without more information

28. Which of the four materials would have the highest **magnetic flux**?

___ 1. Material A
___ 2. Material B
___ 3. Material C
___ 4. Material D

29. Which of the following are used both to control current flow **and** to convert energy into heat?

____ 1. resistors, capacitors and inductors

____ 2. resistors and capacitors

____ 3. inductors only

____ 4. resistors only

30. Which of the terms below does **not** belong with the other three?

____ 1. Impedance

____ 2. Resistance

____ 3. Reluctance

____ 4. Capacitance

31. In which of the following have the correct units of measure been used in the formula E = I x R?

____ 1. watts = volts x amperes

____ 2. amperes = ohms x watts

____ 3. ohms = volts x amperes

____ 4. volts = amperes x ohms

32. Assume that in each diagram below the law of charges is having an effect on the two figures within the rectangle. In which diagram will this effect be **greatest?**

____ 1.

____ 2.

____ 3.

____ 4.

33. Which of the following statements most correctly states the relationship between distance and the strength of magnetic force?

____ 1. increasing distance between the objects increases the affect

____ 2. increasing distance between the objects decreases the affect

____ 3. distance has more affect at some times than at others

____ 4. distance has no affect when objects are heated to certain temperatures

34. In a parallel circuit with several resistances, current flow is:

____ 1. equal in all conductors

____ 2. greatest in the conductor with greatest resistance

____ 3. least in the conductor with greatest resistance

____ 4. increased in proportion to total resistance

35. Current flow would be greatest in a:

____ 1. short wire of great thickness

____ 2. short wire of small thickness

____ 3. long wire of great thickness

____ 4. long wire of small thickness

36. Which of the following **BEST** describes the means by which electric current is obtained?

____ 1. regulating the movement of free electrons

____ 2. applying external energy through a conductor

____ 3. providing a source of resistance to the flow of electrons

____ 4. forcing electrons to break free of atoms

37. Each of the following can be explained by the principles of inductance **EXCEPT:**

____ 1. The transmission of power from one source to another by transformers

____ 2. Energy produced by power applied to one circuit is shared by a second circuit which is not physically connected to the power source

____ 3. Electrostatic energy from the dielectric of a capacitor is discharged when applied voltage is reduced

____ 4. Counter electromotive force is created in a circuit, thus slowing a decline in current level

38. Capacitance can be increased by each of the following **EXCEPT:**

____ 1. Increasing size of plates

____ 2. Increasing distance between plates

____ 3. Using dielectric material of less thickness

____ 4. Using dielectric material with better insulating qualities

39. In a circuit with capacitors, inductors, and resistors, total opposition to current flow is known as:

____ 1. reactance

____ 2. impedance

____ 3. ohmic value

____ 4. current lag

40. The relationship between the windings of primary and secondary transformer coils is known as the:

____ 1. voltage ratio

____ 2. current ratio

____ 3. turns ratio

____ 4. phase ratio

41. Which of the following describes the amount of AC current that effectively produces the same amount of energy as DC of equal value:

____ 1. peak value

____ 2. output current

____ 3. average value

____ 4. root mean square

42. Which device is used to regulate AC current by storing electrons?

___ 1. capacitors
___ 2. resistors
___ 3. inductors
___ 4. chokes

43. A resistor is color coded orange, blue, brown. What is the value of this resistor in ohms?

___ 1. 36 ohms
___ 2. 360 ohms
___ 3. 361 ohms
___ 4. 3610 ohms

44. The tolerance of the resistor described in question 43 would be:

___ 1. cannot be determined without more information
___ 2. ± 5%
___ 3. ± 10%
___ 4. ± 20%

45. For a circuit requiring 5 ohms of resistance, you would use which of the following resistors?

___ 1. Black, Black, Green
___ 2. Black, Green, Black
___ 3. Green, Black, Silver
___ 4. Green, Black, Gold

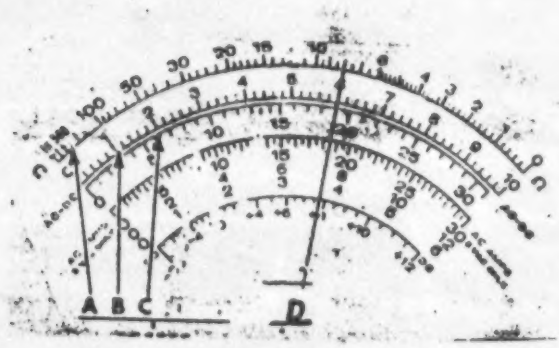
46. 430 actual ohms of resistance can be obtained from each of the following **EXCEPT:**

___ 1. A 400 ohm resistor with no fourth band.
___ 2. A 400 ohm resistor with a silver fourth band.
___ 3. A 500 ohm resistor with no fourth band.
___ 4. A 500 ohm resistor with a silver fourth band.

47. A resistor coded with three bands of white, white, silver will supply:

___ 1. approximately 10 ohms of resistance.
___ 2. 99 ohms of resistance.
___ 3. less than 2 ohms at its high range.
___ 4. a minimum of 1 ohm at its low range.

Questions 48 - 50 all refer to the figure below.



48. In the figure above which indicated readings should be shifted to another range for accuracy?

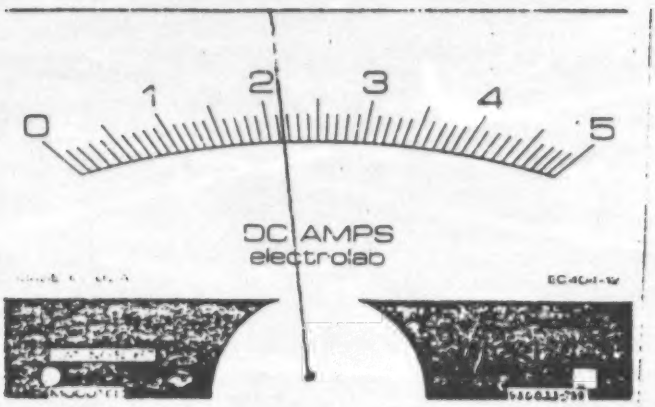
____ 1. C and D
____ 2. A and B
____ 3. A and D
____ 4. All of them

49. If the voltage range switch is set on 1000V AC, what is the voltage reading, pointer D?

____ 1. 60 volts AC
____ 2. 190 volts AC
____ 3. 600 volts AC
____ 4. 600 volts DC

50. With the range switch set on R x 10K, what is the reading of pointer D?

____ 1. 8 ohms
____ 2. 8,000 ohms
____ 3. 68,000 ohms
____ 4. 80,000 ohms



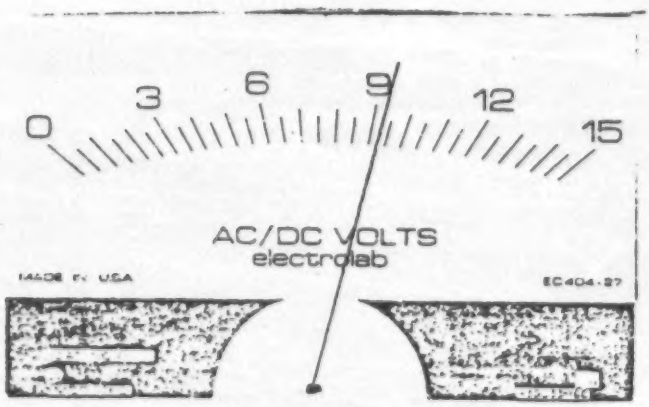
51. The meter above is reading:

___ 1. 2.15 amperes DC

___ 2. 21.5 amperes DC

___ 3. 21.5 amperes AC

___ 4. 2.15 amperes AC



52. This meter is reading, on DC selection:

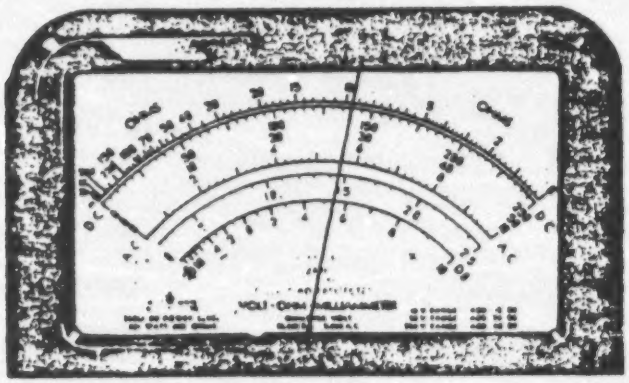
___ 1. 9.5 volts DC

___ 2. 9.4 volts DC

___ 3. 9.25 volts DC

___ 4. 9.1 volts DC

53. Determine the correct reading from the given meter indication.



Function Switch + DC
Range Switch 100 MA

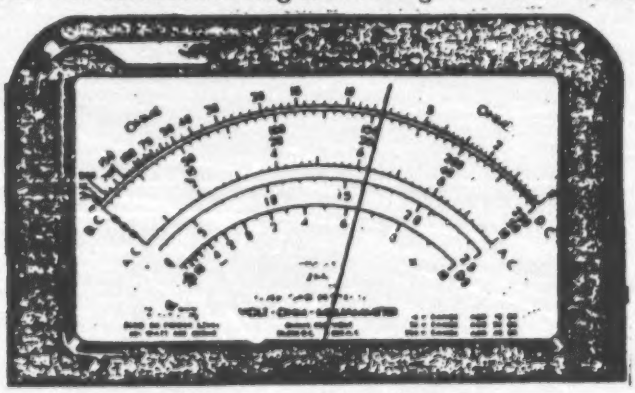
___ 1. 9mA

___ 2. 28mA

___ 3. 56mA

___ 4. 240mA

54. Determine the correct reading from the given meter indication.



Function Switch + DC
Range Switch RX 10,000

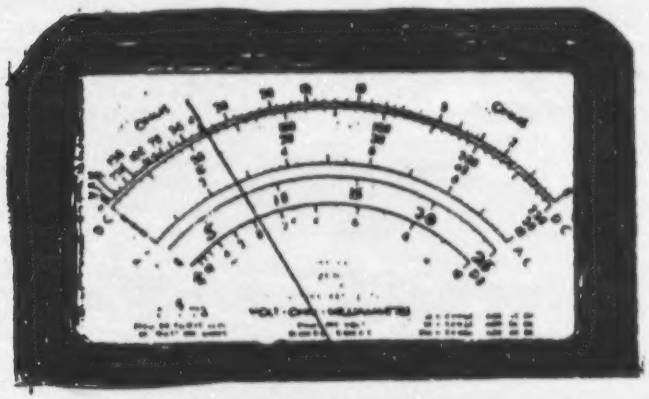
___ 1. 155 ohms

___ 2. 1,550 ohms

___ 3. 7,500 ohms

___ 4. 75,000 ohms

55. Determine the correct reading from the given meter indication.



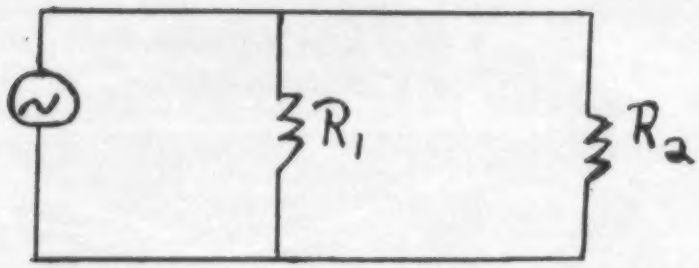
Function Switch + DC
Range Switch 2.5V

____ 1. .4 volt

____ 2. .6 volt

____ 3. 40 volts

____ 4. 60 volts



Use this schematic for questions 56 - 59.

56. In the given circuit, if applied voltage is 120 volts, R_1 = 20 ohms, and R_2 = 30 ohms, what is the total current?

____ 1. 2.4 amperes
____ 2. 10 amperes
____ 3. 12 amperes
____ 4. 120 amperes

57. In the given circuit, if E_T = 150 volts, R_1 = 20 ohms and R_2 = 30 ohmd, determine the current through R_2.

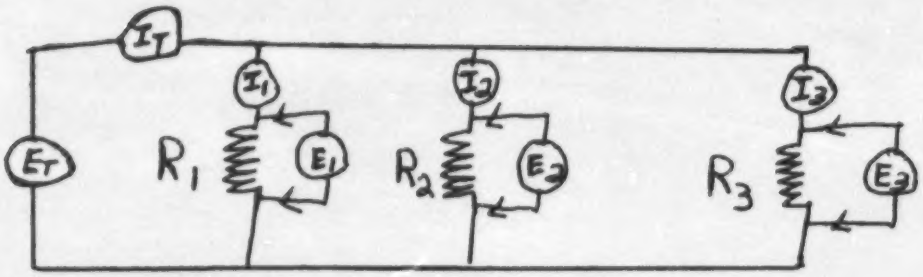
____ 1. 3 amperes
____ 2. 5 amperes
____ 3. 6 amperes
____ 4. 12.5 amperes

58. If 3 amperes of current flow across R_1 and there is a voltage drop of 120 volts across R_2, what is the voltage drop across R_1?

____ 1. not enough information to determine
____ 2. 120 volts
____ 3. 240 volts
____ 4. 360 volts

59. Determine total resistance in the given circuit if R_1 = 10 ohms and R_2 = 30 ohms.

____ 1. 3 ohms
____ 2. 7.5 ohms
____ 3. 20 ohms
____ 4. 40 ohms



Use this schematic for questions 60 - 63.

60. In the circuit, if E_T = 100 volts, R_T = 10 ohms and I_1 = 4 amperes, then I_3 is equal to:

___ 1. 4 amperes
___ 2. 6 amperes
___ 3. 10 amperes
___ 4. not enough information to determine

61. In the circuit, if R_T = 3 ohms, I_1 = 6 amperes, I_2 = 3 amperes, and I_3 = 1 ampere, what is the total circuit current?

___ 1. 3.3 amperes
___ 2. 10 amperes
___ 3. 30 amperes
___ 4. not enough information to determine

62. If R_1 = 6 ohms, I_1 = 4 amperes and R_T = 2 ohms, then E_T equals:

___ 1. 24 volts
___ 2. 16 volts
___ 3. 8 volts
___ 4. none of these

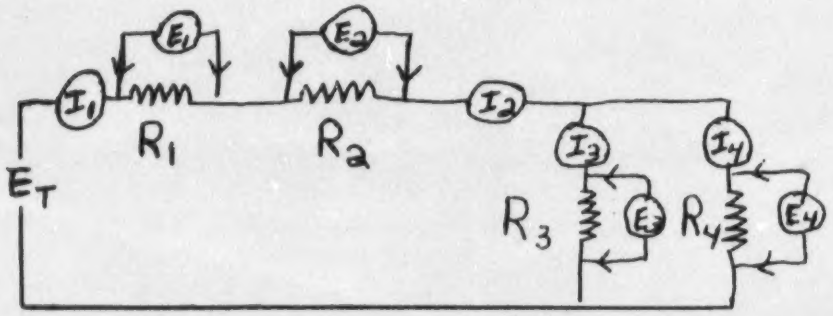
63. Determine total resistance in the given circuit if I_T = 10 amperes, R_1 = 5 ohms, R_2 = 10 ohms, and R_3 = 30 ohms.

___ 1. 45 ohms
___ 2. 33.3 ohms
___ 3. 4.5 ohms
___ 4. 3 ohms

64. In a circuit three 6 ohms resistors are connected in parallel across 120 volts. The total resistance in this circuit is equal to:

___ 1. 2 ohms
___ 2. 6 ohms
___ 3. 12 ohms
___ 4. 18 ohms

Questions 65 - 69 are all based on the following schematic.



65. If E_1 = 40 volts, E_2 = 60 volts, E_3 = 30 volts, and E_4 = 30 volts, then E_T is:

___ 1. 100 volts
___ 2. 115 volts
___ 3. 130 volts
___ 4. 160 volts

66. If E_1 = 10 volts, E_3 = 7.5 volts, E_4 = 7.5 volts, and E_T = 32.5 volts what is E_2 =

___ 1. 7.5 volts
___ 2. 10 volts
___ 3. 15 volts
___ 4. 25 volts

67. If E_T = 65 volts and R_T = 26 ohms, then I_T is:

___ 1. 25 amperes
___ 2. 13.5 amperes
___ 3. 2.5 amperes
___ 4. 1.25 amperes

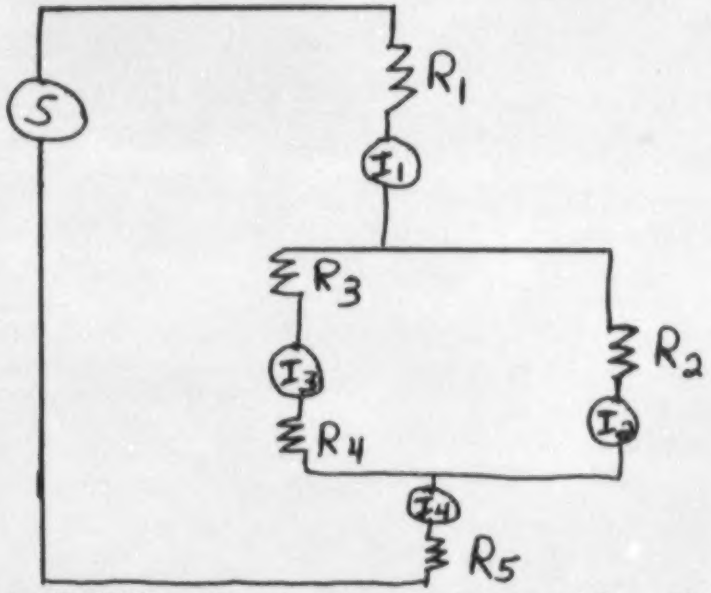
68. If current I_2 is 10 amperes, and I_3 is 4 amperes, then I_4 is:

___ 1. 4 amperes
___ 2. 5 amperes
___ 3. 6 amperes
___ 4. 10 amperes

69. If R_1 = 4 ohms, R_2 = 6 ohms, R_3 = 4 ohms, and R_4 = 12 ohms, then R_T =

___ 1. 13 ohms
___ 2. 16 ohms
___ 3. 18 ohms
___ 4. 26 ohms

Questions 70 - 72 are all based on the following schematic.



70. In the given circuit, if E_T = 100 volts, I_1 = 4 amperes, and R_2 = 20 ohms then I_2 is equal to:

___ 1. 2 amperes
___ 2. 4 amperes
___ 3. 5 amperes
___ 4. not enough information to determine

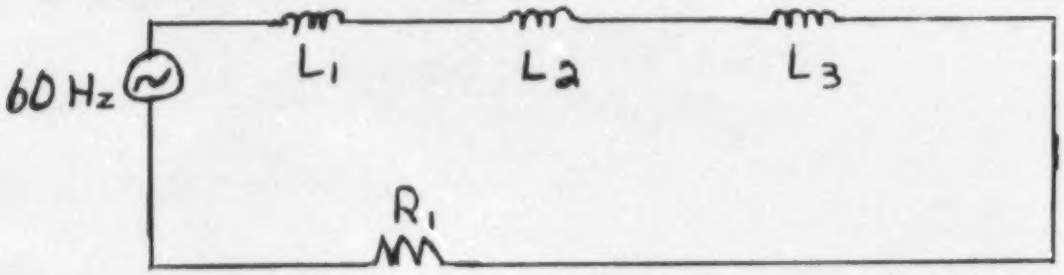
71. If E_{R_1} = 20 volts, E_{R_3} = 20V, E_{R_4} = 20 volts and E_{R_5} = 40 volts, what is the voltage drop at resistor R_2?

___ 1. 10 volts
___ 2. 20 volts
___ 3. 20 volts
___ 4. 40 volts

72. If I_T = 8 amperes and R_1 = 3 ohms, R_2 = 10 ohms, R_3 = 5 ohms, R_4 = 5 ohms and R_5 = 5 ohms, determine the applied voltage in the circuit.

___ 1. 104 volts
___ 2. 144 volts
___ 3. 184 volts
___ 4. 225 volts

Questions 73 and 74 both refer to the following schematic:



73. Calculate total inductance from the given circuit if L_1 = 20 henry, L_2 = 30 henry, L_3 = 60 henry and R_1 = 5 ohms.

___ 1. 10 henry
___ 2. 35 henry
___ 3. 110 henry
___ 4. 115 henry

74. If in the given circuit resistance is equal to 4 ohms and inductive reactance is equal to 3 ohms then circuit impedance is equal to:

___ 1. 1.7 ohms
___ 2. 5 ohms
___ 3. 7 ohms
___ 4. 12 ohms

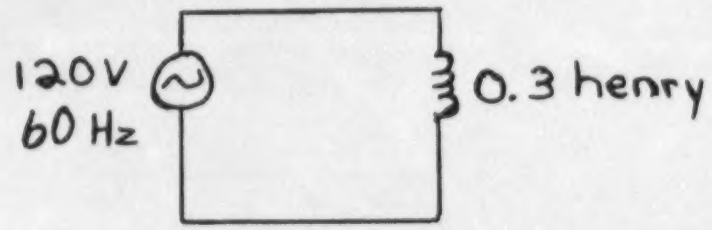
75. Two inductors of .6 henrys are hooked in series. Total inductance would be:

___ 1. .3 henry
___ 2. .36 henry
___ 3. .6 henry
___ 4. 1.2 henrys

76. Two 10 henry inductors are connected in parallel with a 100 ohm resistor. In this circuit, total inductance will be:

___ 1. 5 henrys
___ 2. 10 henrys
___ 3. 20 henrys
___ 4. 110 henrys

77. Determine inductive reactance from the given circuit.



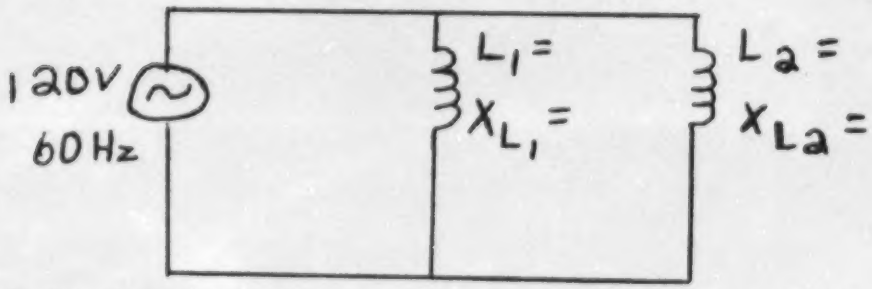
___ 1. 18 ohms

___ 2. 113 ohms

___ 3. 147ohms

___ 4. 180 ohms

Questions 78 and 79 both refer to the following schematic:



78. In the given circuit, if L_1 = 8 henrys and L_2 = 8 henrys, total inductance would be equal to:

___ 1. 4 henrys

___ 2. 8 henrys

___ 3. 16 henrys

___ 4. 64 henrys

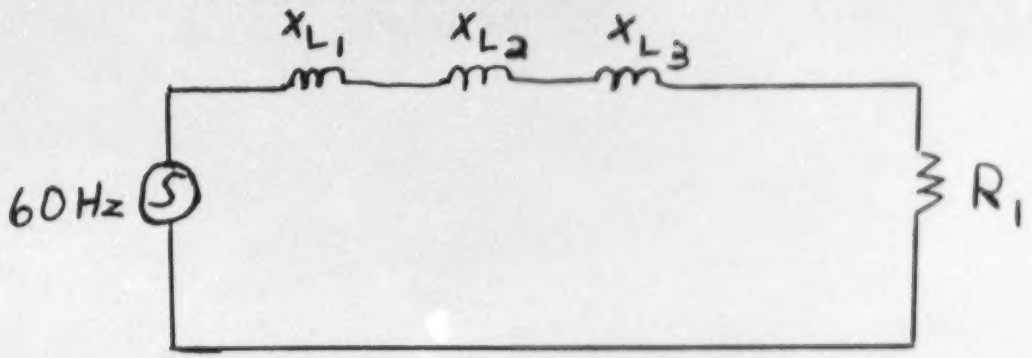
79. If X_{L_1} = 5 ohms and X_{L_2} = 20 ohms, inductive reactance would be equal to:

___ 1. 4 ohms

___ 2. 25 ohms

___ 3. 100 ohms

___ 4. 9420 ohms



Questions 80 and 81 both refer to the schematic pictured above.

80. If X_{L_1} = 5 ohms, X_{L_2} = 10 ohms, X_{L_3} = 15 ohms and R_1 = 30 ohms total inductive reactance in the given circuit is equal to:

___ 1. 2.5 ohms
___ 2. 2.73 ohms
___ 3. 30 ohms
___ 4. 60 ohms

81. If total inductive reactance in the given circuit is equal to 8 ohms, and R_1 is equal to 6 ohms, impedance is equal to:

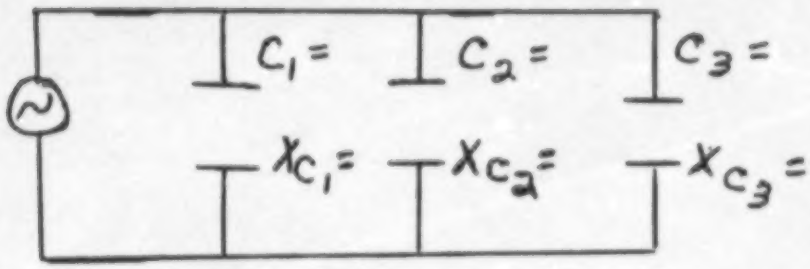
___ 1. 3.4 ohms
___ 2. 10 ohms
___ 3. 14 ohms
___ 4. 3014 ohms

82. What voltage is required in a 60 hz circuit with inductive reactance of 60 ohms, resistance of 40 ohms and impedance of 72 ohms in order to obtain 5 amperes of flow?

___ 1. 200 volts
___ 2. 300 volts
___ 3. 360 volts
___ 4. 860 volts

83. A 120V 60 hz circuit with inductive reactance of 25 ohms, resistance of 10 ohms, and impedance of 27 ohms, would carry a current flow of:

___ 1. 1.9 amperes
___ 2. 3.4 amperes
___ 3. 4.4 amperes
___ 4. 12 amperes



Questions 84 and 85 refer to the schematic pictured above.

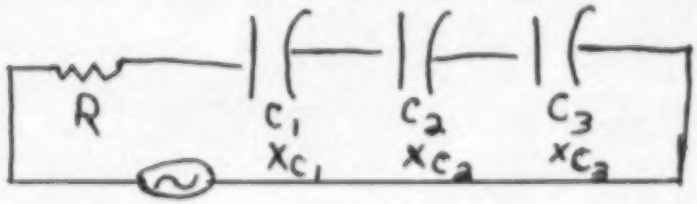
84. Calculate total capacitance from the given circuit if C_1 = 30 uf, C_2 = 30 uf, and C_3 = 30 uf.

___ 1. 10 uf
___ 2. 30 uf
___ 3. 90 uf
___ 4. 300 uf

85. If X_{C_1} = 100 ohms, X_{C_2} = 100 ohms, and X_{C_3} = 200 ohms, total capacitive reactance is equal to:

___ 1. 40 ohms
___ 2. 133.3 ohms
___ 3. 400 ohms
___ 4. 5000 ohms

Question 86 - 88 all refer to the schematic pictured below.



86. In the given circuit, if C_1 = 25 uf, C_2 = 50 uf, and C_3 = 25 uf, total capacitance is equal to:

___ 1. 10 uf
___ 2. 33.3 uf
___ 3. 100 uf
___ 4. 312.5 uf

87. If X_{C_1} = 10 ohms, X_{C_2} = 25 ohms and X_{C_3} = 5 ohms, and R = 5 ohms, capacitive reactance is equal to:

___ 1. 2.9 ohms
___ 2. 31.25 ohms
___ 3. 40 ohms
___ 4. 45 ohms

88. With total capacitive reactance of 20 ohms, resistance of 30 ohms, and voltage of 220V, 60 hz. what current will flow in the circuit.

___ 1. 4.4 amperes
___ 2. 6.1 amperes
___ 3. 11 amperes
___ 4. 12 amperes

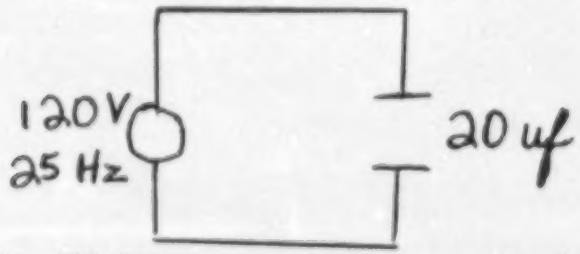
89. Two 30 microfarad capacitors are hooked in series. C_T is equal to:

___ 1. 15 microfarads
___ 2. 30 microfarad
___ 3. 60 microfarads
___ 4. 900 microfarads

90. 10 microfarads, 20 microfarads, and 30 microfarads are hooked in parallel. C_T is equal to:

___ 1. 5.45 microfarads
___ 2. 18 microfarads
___ 3. 20 microfarads
___ 4. 60 microfarads

91. Determine capacitive reactance from the given circuit.



___ 1. 165 ohms
___ 2. 318 ohms
___ 3. 416 ohms
___ 4. 3,140 ohms

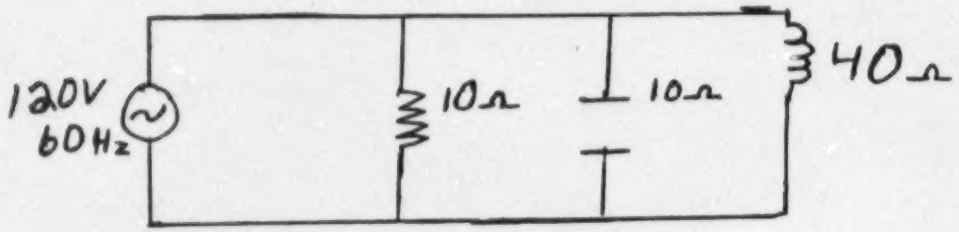
92. What current will be obtained in a circuit with 300 ohms resistance, 400 ohms of capacitive reactance and impedance of 500 ohms, if applied voltage is 100V?

___ 1. .2 amperes
___ 2. .25 amperes
___ 3. 3 amperes
___ 4. not enough information to determine

93. With 120 volts, 60 hz applied to a parallel circuit containing 10 ohms of resistance, 10 ohms X_1, and 40 ohms X_C, what is total impedance?

___ 1. 8 ohms
___ 1. 10 ohms
___ 3. 40 ohms
___ 4. 50 ohms

94. Determine total impedance from the given circuit.



___ 1. 8 ohms

___ 2. 10 ohms

___ 3. 40 ohms

___ 4. 60 ohms

95. A 6.6 microfarad capacitor with capacitive reactance of 402.11 ohms is connected in series with a 200 ohms resistor and an inductor with 400 ohms inductance reactance. If applied voltage is 200 volts at 60 hz, then current flow will be approximately:

___ 1. 0.2 amperes

___ 2. 0.35 amperes

___ 3. 0.5 amperes

___ 4. 1 ampere

96. A series circuit containing a 30 ohm resistor, inductive reactance of 210 ohms, and capacitive reactance of 250 ohms has a 200 volts power source. What is the current flow in this circuit?

___ 1. .88 amperes

___ 2. 1 ampere

___ 3. 4.4 amperes

___ 4. 7.3 amperes